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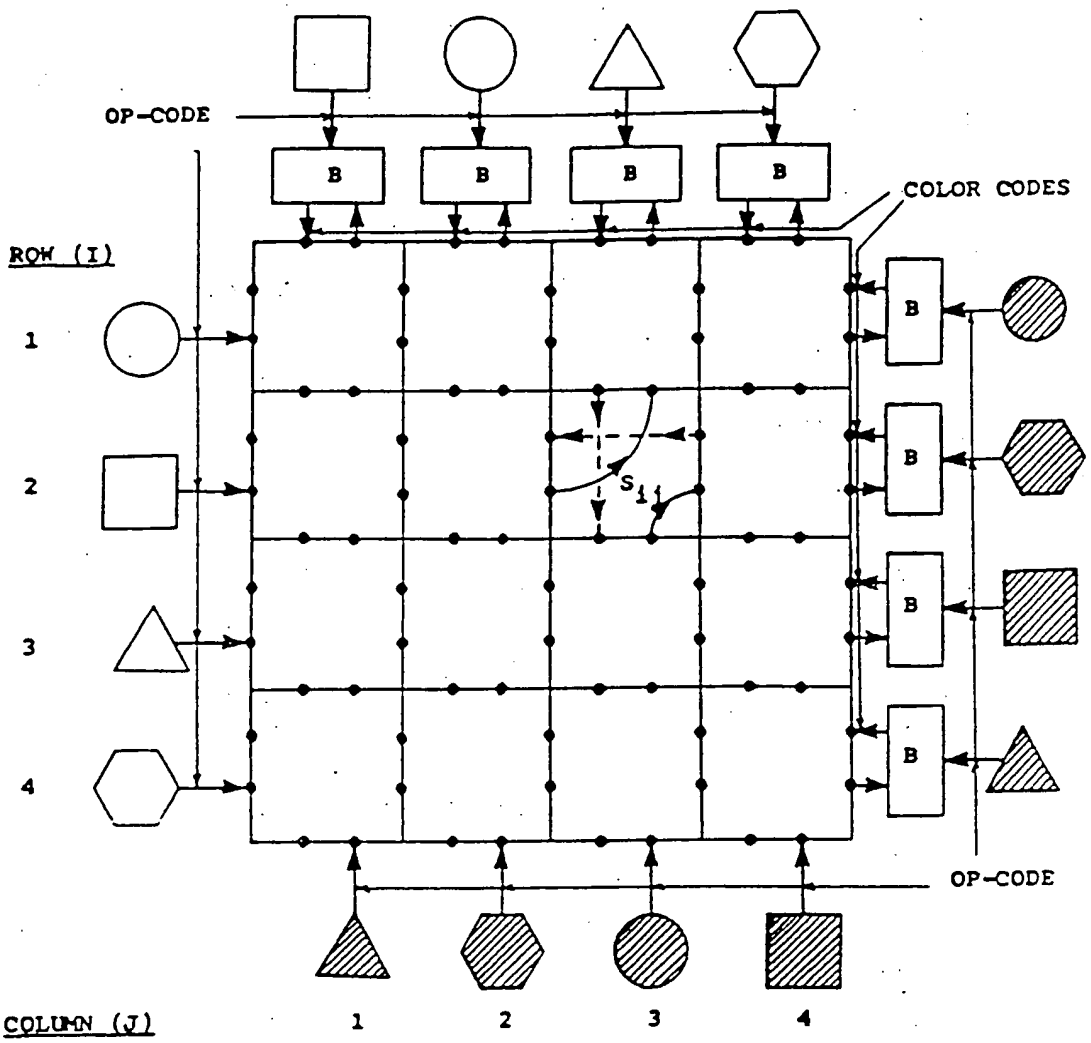
PATENT & TRADEMARK OFFICE



B: BOOLEAN FUNCTION

OBJECT	○	⬡	□	△	●	⬢	■	▲
OP-CODE	000	001	010	011	100	101	110	111

GEOMETRIC LAYOUT OF DEVICE FOR N = 4

FIG. 1

BEST AVAILABLE COPY

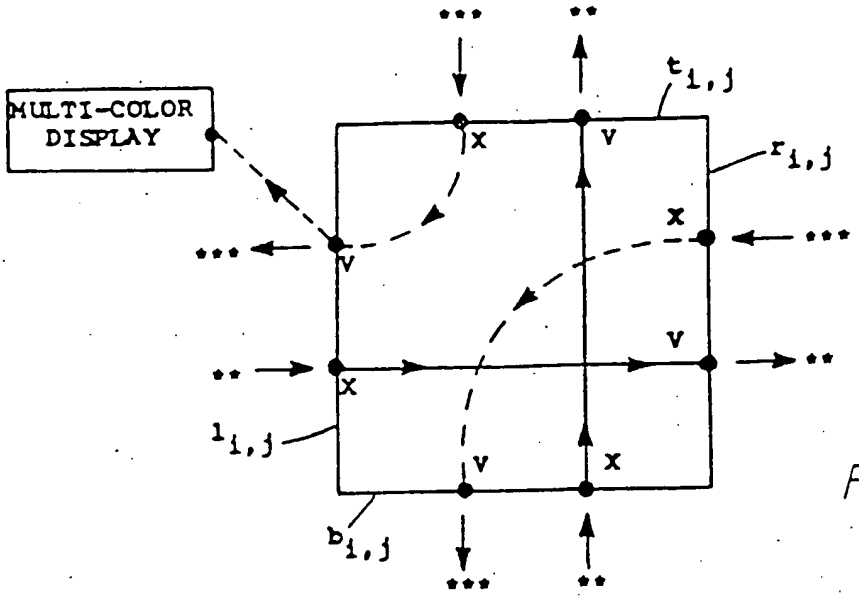


FIG. 2a

SWITCH $W_{i,j}$: ON ("1")

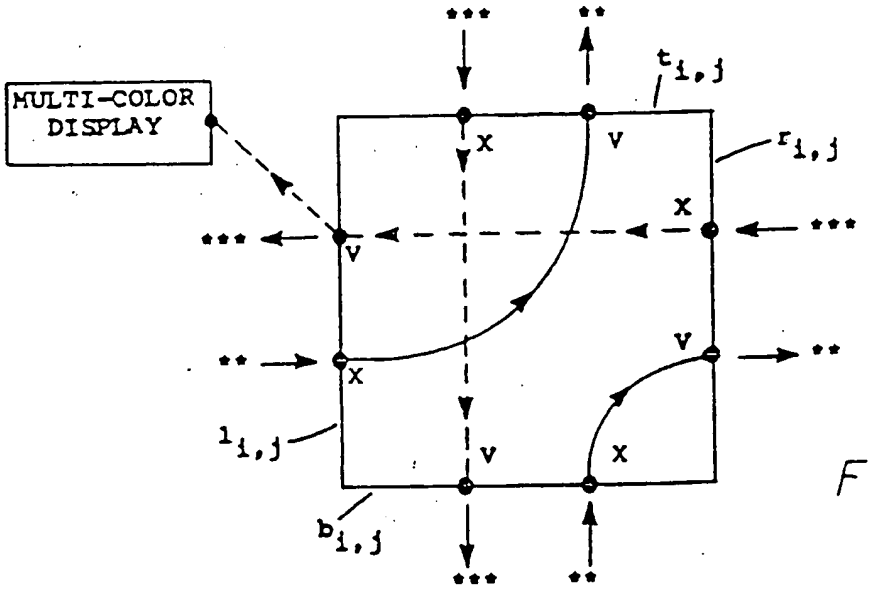
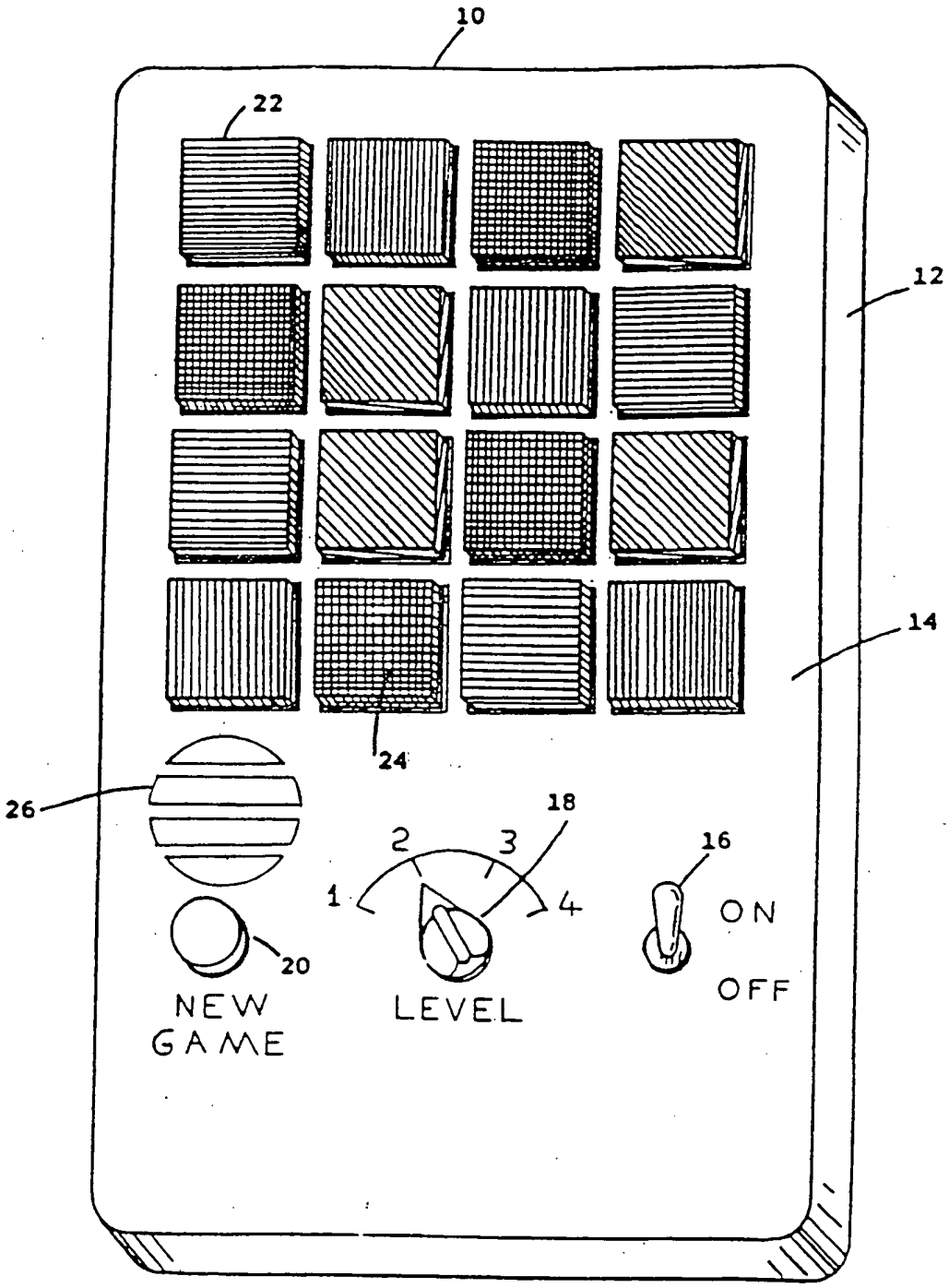


FIG. 2b

SWITCH $W_{i,j}$: OFF ("0")

LEGEND: ** OP-CODE
*** COLOR CODE

ROUTING SQUARE $S_{i,j}$



HAND HELD LOGIC GAME DEVICE

FIG. 3

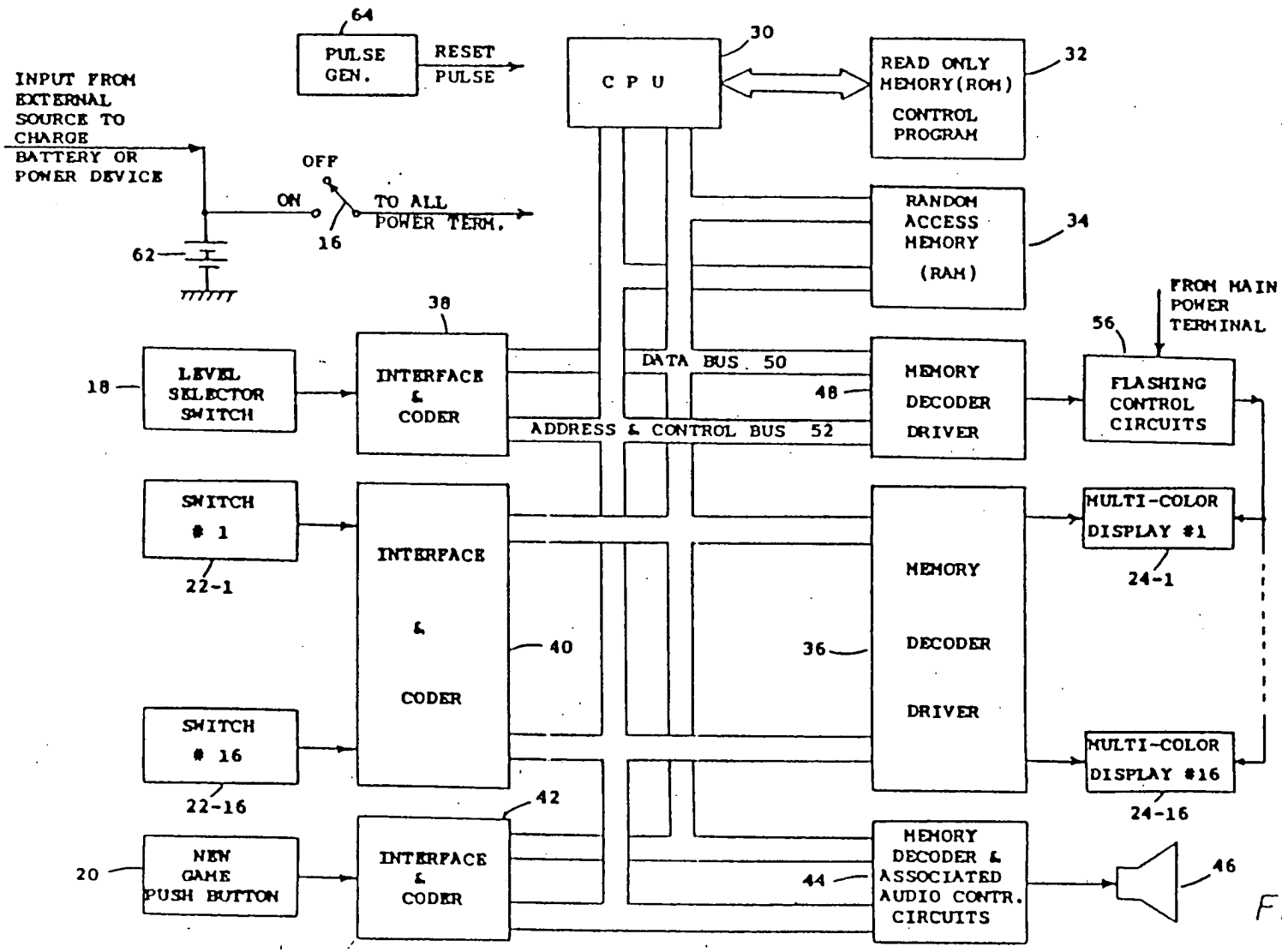

64
PULSE GEN.
RESET PULSE
30
C P U
32
READ ONLY MEMORY(ROM)
CONTROL PROGRAM
INPUT FROM EXTERNAL SOURCE TO CHARGE BATTERY OR POWER DEVICE
OFF
ON
TO ALL POWER TERM.
16
62
34
RANDOM ACCESS MEMORY (RAM)
FROM MAIN POWER TERMINAL
56
38
18
LEVEL SELECTOR SWITCH
INTERFACE & CODER
DATA BUS 50
48
MEMORY DECODER DRIVER
FLASHING CONTROL CIRCUITS
ADDRESS & CONTROL BUS 52
SWITCH # 1
22-1
INTERFACE & CODER
40
MEMORY DECODER DRIVER
36
MULTI-COLOR DISPLAY #1
24-1
SWITCH # 16
22-16
42
20
NEW GAME PUSH BUTTON
INTERFACE & CODER
44
MEMORY DECODER & ASSOCIATED AUDIO CONTR. CIRCUITS
46
MULTI-COLOR DISPLAY #16
24-16

FIG. 4

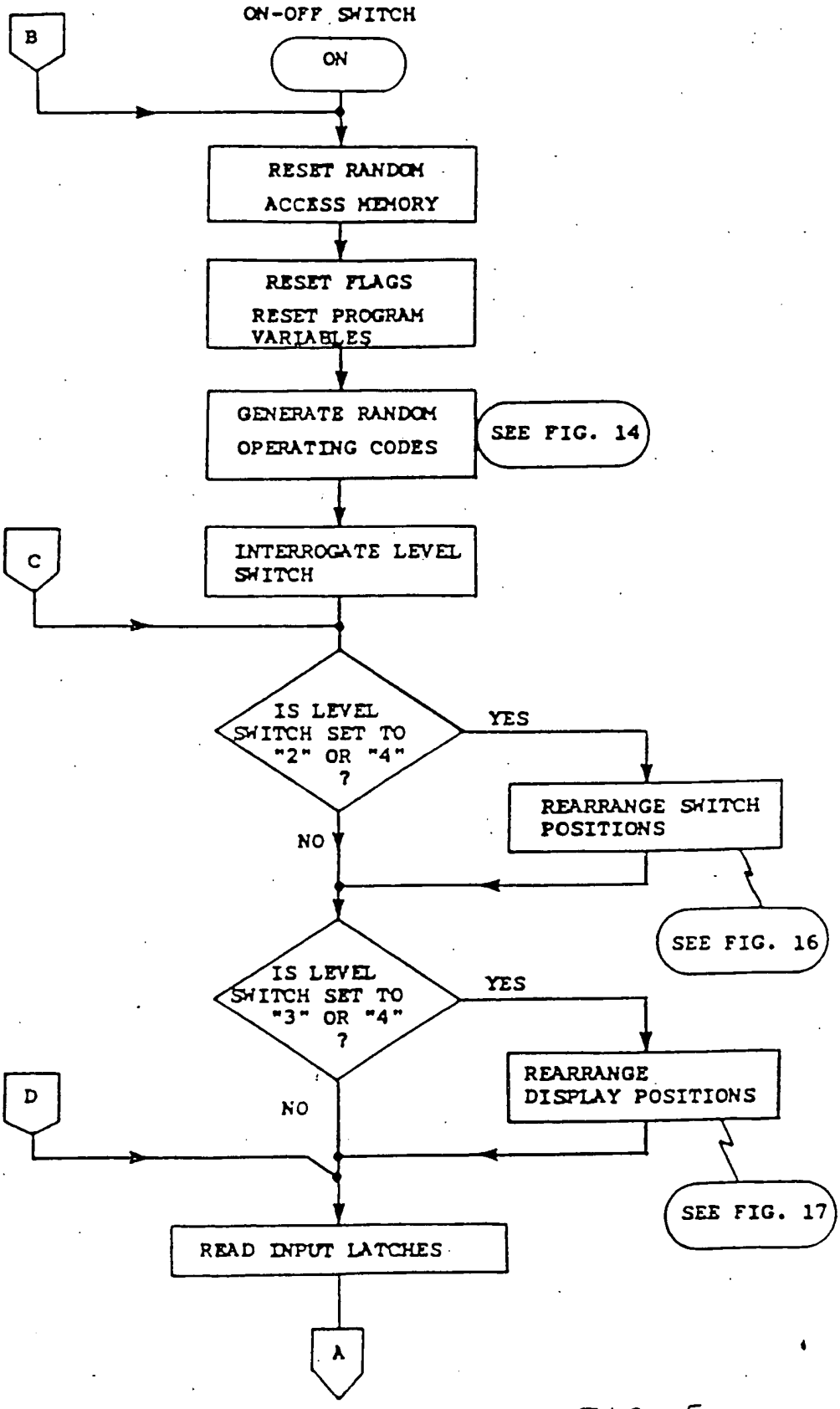

ON-OFF SWITCH
B
ON
RESET RANDOM ACCESS MEMORY
RESET FLAGS
RESET PROGRAM VARIABLES
GENERATE RANDOM OPERATING CODES
SEE FIG. 14
C
INTERROGATE LEVEL SWITCH
IS LEVEL SWITCH SET TO "2" OR "4" ?
YES
REARRANGE SWITCH POSITIONS
NO
SEE FIG. 16
IS LEVEL SWITCH SET TO "3" OR "4" ?
YES
REARRANGE DISPLAY POSITIONS
D
NO
SEE FIG. 17
READ INPUT LATCHES
A

FIG. 5

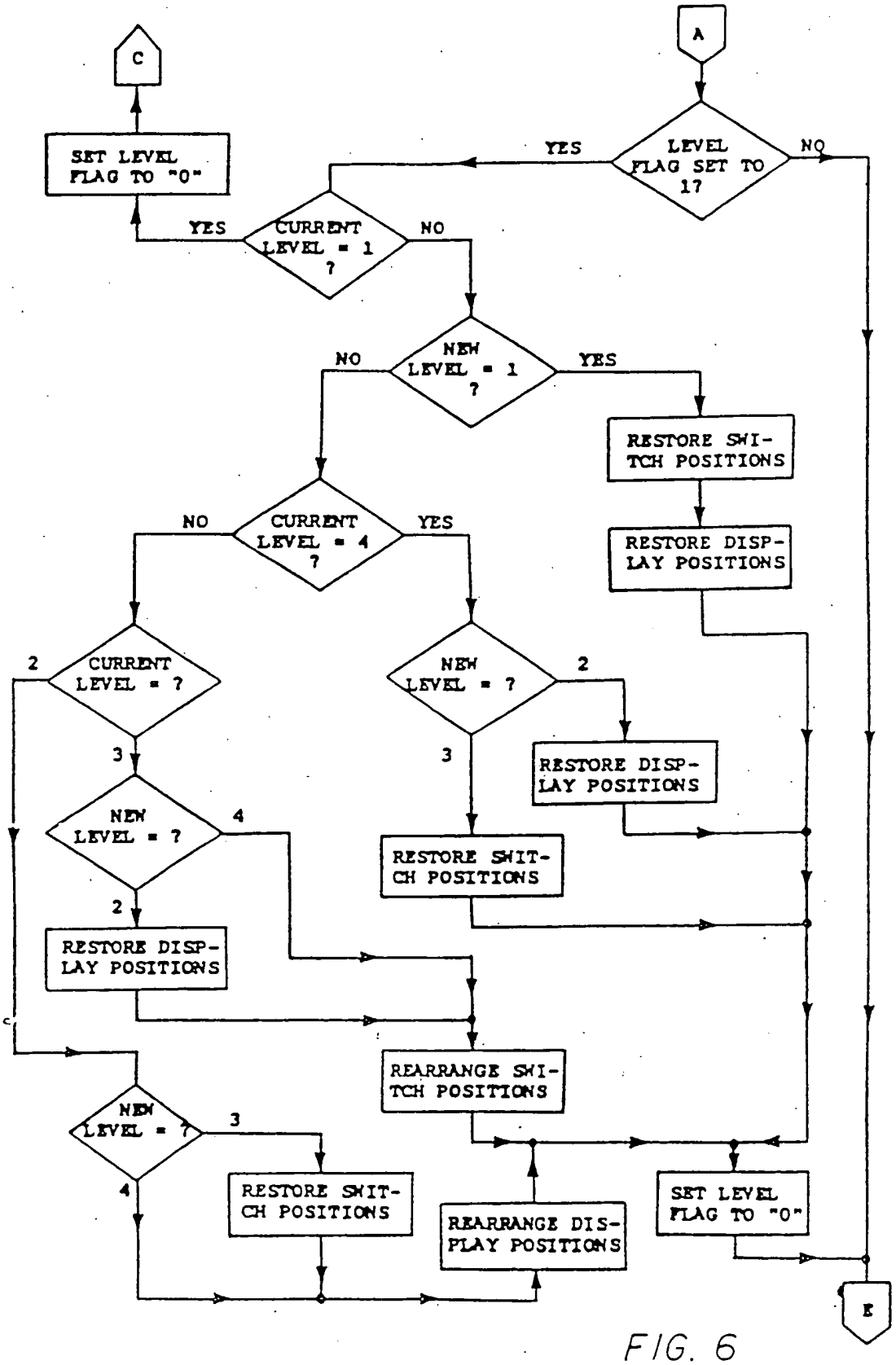

A
C
LEVEL FLAG SET TO 17
YES
NO
SET LEVEL FLAG TO "0"
YES
CURRENT LEVEL = 1 ?
NO
NO
NEW LEVEL = 1 ?
YES
RESTORE SWITCH POSITIONS
RESTORE DISPLAY POSITIONS
NO
CURRENT LEVEL = 4 ?
YES
2
CURRENT LEVEL = ?
NEW LEVEL = ?
2
3
3
NEW LEVEL = ?
4
RESTORE DISPLAY POSITIONS
RESTORE SWITCH POSITIONS
2
RESTORE DISPLAY POSITIONS
REARRANGE SWITCH POSITIONS
NEW LEVEL = ?
3
4
RESTORE SWITCH POSITIONS
REARRANGE DISPLAY POSITIONS
SET LEVEL FLAG TO "0"
E

FIG. 6

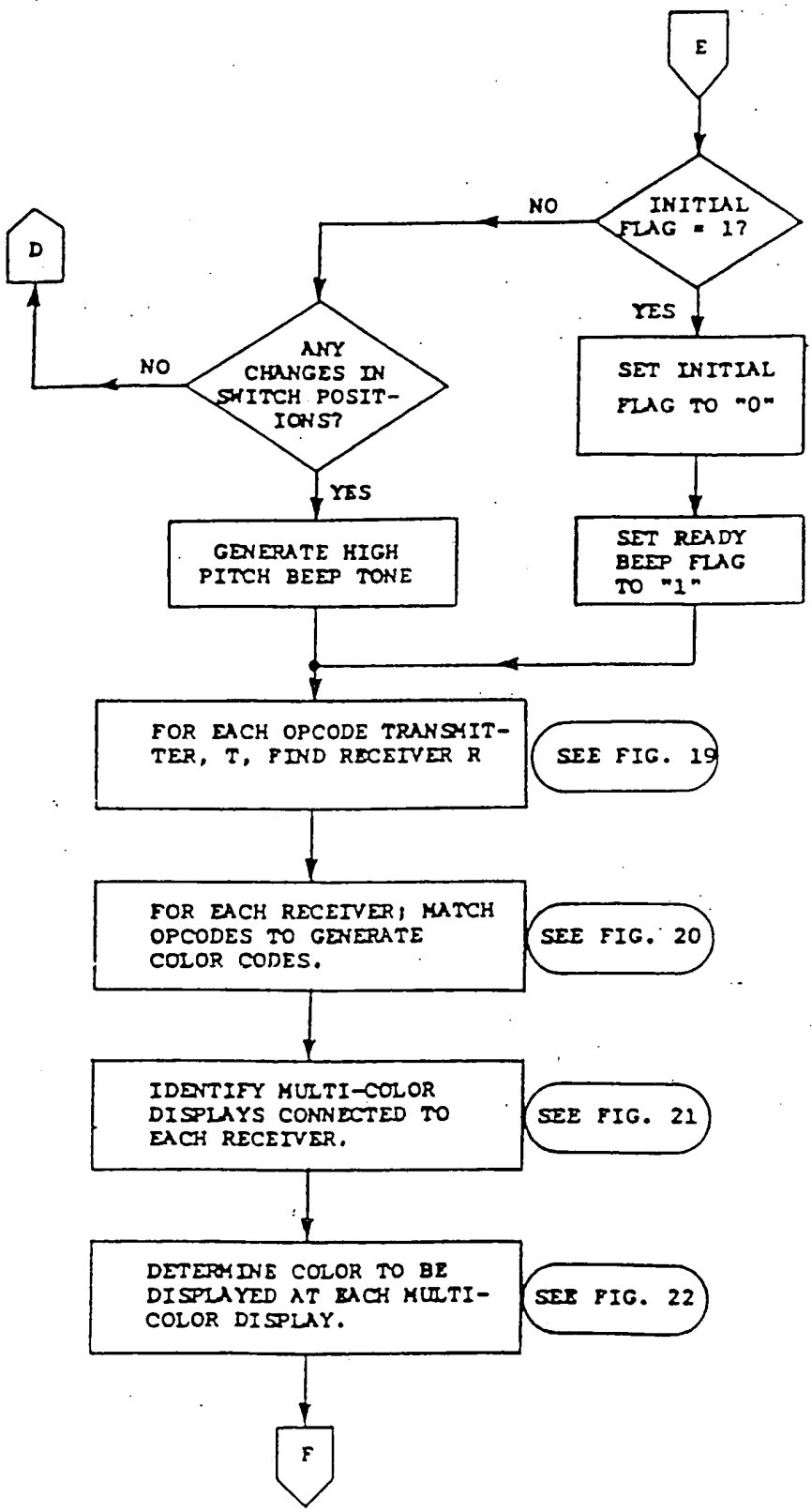

E
INITIAL FLAG = 1?
NO
YES
D
ANY CHANGES IN SWITCH POSITIONS?
NO
YES
SET INITIAL FLAG TO "0"
GENERATE HIGH PITCH BEEP TONE
SET READY BEEP FLAG TO "1"
FOR EACH OPCODE TRANSMITTER, T, FIND RECEIVER R
SEE FIG. 19
FOR EACH RECEIVER; MATCH OPCODES TO GENERATE COLOR CODES.
SEE FIG. 20
IDENTIFY MULTI-COLOR DISPLAYS CONNECTED TO EACH RECEIVER.
SEE FIG. 21
DETERMINE COLOR TO BE DISPLAYED AT EACH MULTI-COLOR DISPLAY.
SEE FIG. 22
F

FIG. 7

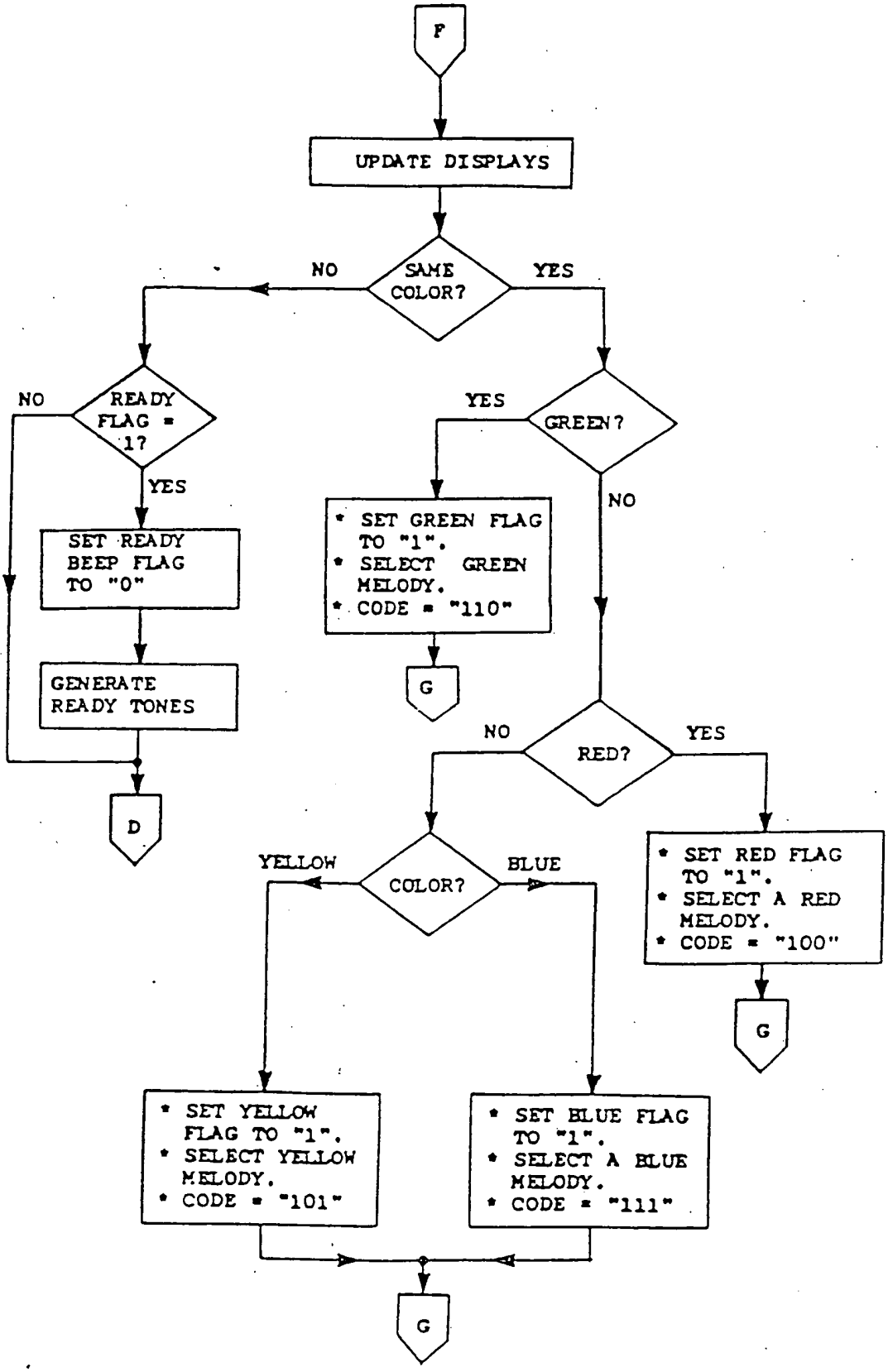

F
UPDATE DISPLAYS
SAME COLOR?
NO
YES
READY FLAG = 1?
NO
YES
SET READY BEEP FLAG TO "0"
GENERATE READY TONES
D
GREEN?
YES
NO
* SET GREEN FLAG TO "1".
* SELECT GREEN MELODY.
* CODE = "110"
G
RED?
NO
YES
* SET RED FLAG TO "1".
* SELECT A RED MELODY.
* CODE = "100"
G
COLOR?
YELLOW
BLUE
* SET YELLOW FLAG TO "1".
* SELECT YELLOW MELODY.
* CODE = "101"
* SET BLUE FLAG TO "1".
* SELECT A BLUE MELODY.
* CODE = "111"
G

FIG. 8

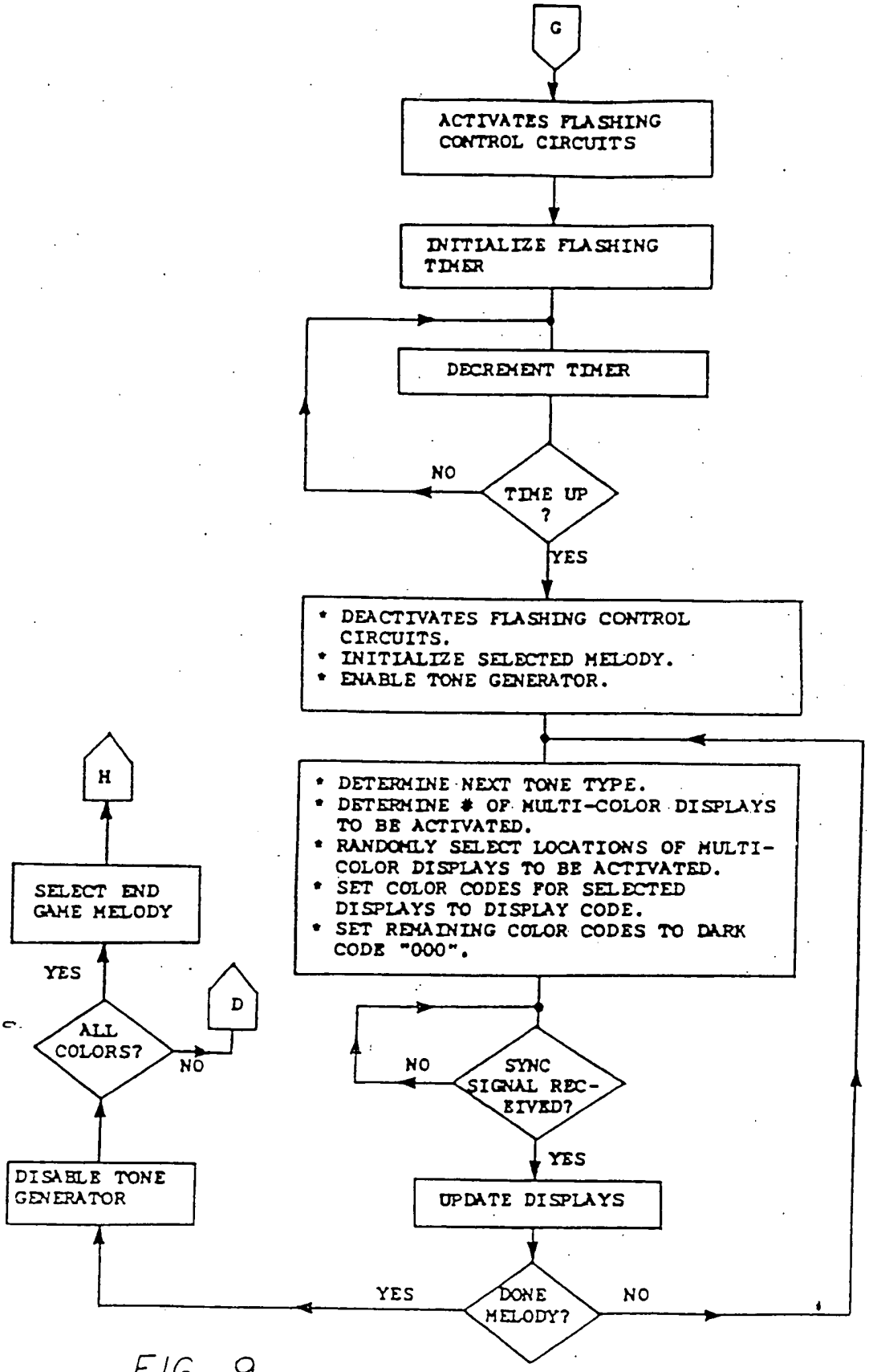

G
ACTIVATES FLASHING CONTROL CIRCUITS
INITIALIZE FLASHING TIMER
DECREMENT TIMER
NO
TIME UP ?
YES
* DEACTIVATES FLASHING CONTROL CIRCUITS.
* INITIALIZE SELECTED MELODY.
* ENABLE TONE GENERATOR.
* DETERMINE NEXT TONE TYPE.
* DETERMINE # OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
* RANDOMLY SELECT LOCATIONS OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
* SET COLOR CODES FOR SELECTED DISPLAYS TO DISPLAY CODE.
* SET REMAINING COLOR CODES TO DARK CODE "000".
NO
SYNC SIGNAL RECEIVED?
YES
UPDATE DISPLAYS
YES
DONE MELODY?
NO
DISABLE TONE GENERATOR
ALL COLORS?
NO
D
YES
SELECT END GAME MELODY
H

FIG. 9

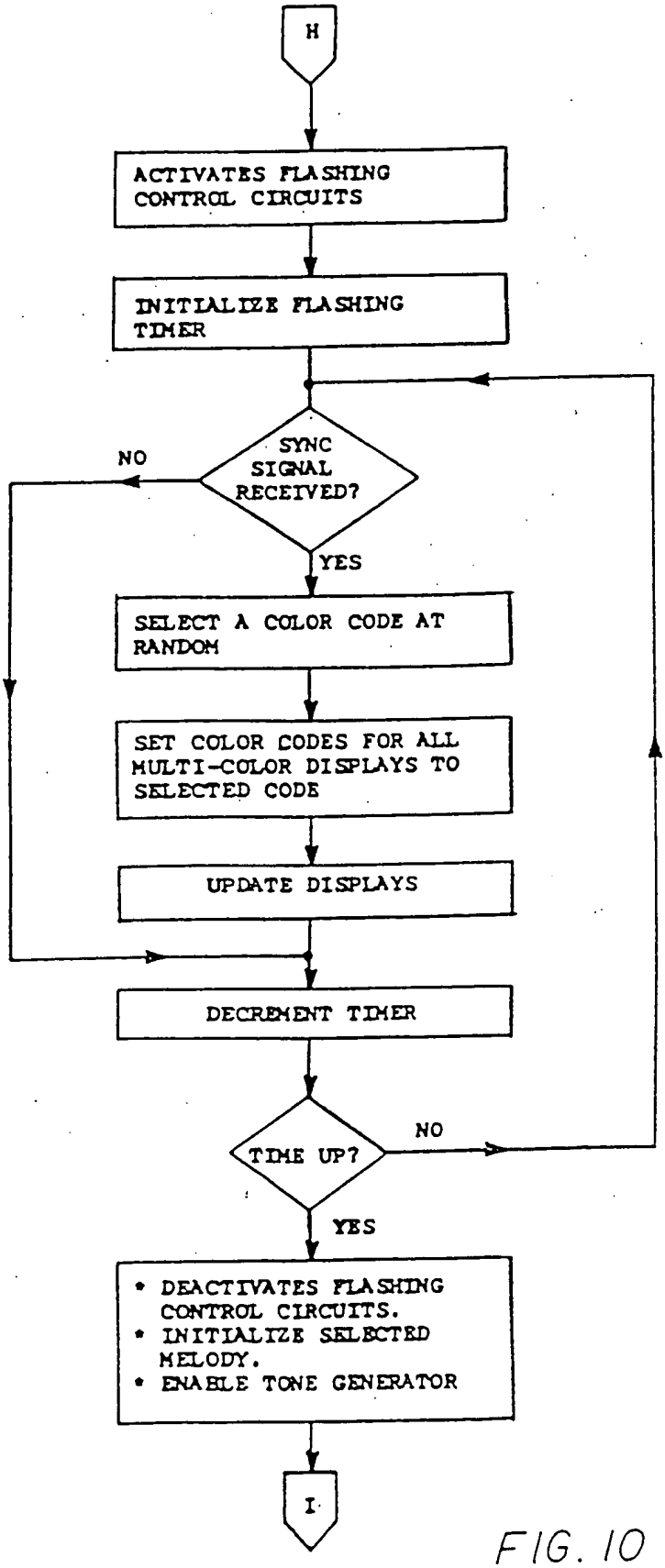

H
ACTIVATES FLASHING CONTROL CIRCUITS
INITIALIZE FLASHING TIMER
SYNC SIGNAL RECEIVED?
NO
YES
SELECT A COLOR CODE AT RANDOM
SET COLOR CODES FOR ALL MULTI-COLOR DISPLAYS TO SELECTED CODE
UPDATE DISPLAYS
DECREMENT TIMER
TIME UP?
NO
YES
• DEACTIVATES FLASHING CONTROL CIRCUITS.
• INITIALIZE SELECTED MELODY.
• ENABLE TONE GENERATOR
I

FIG. 10

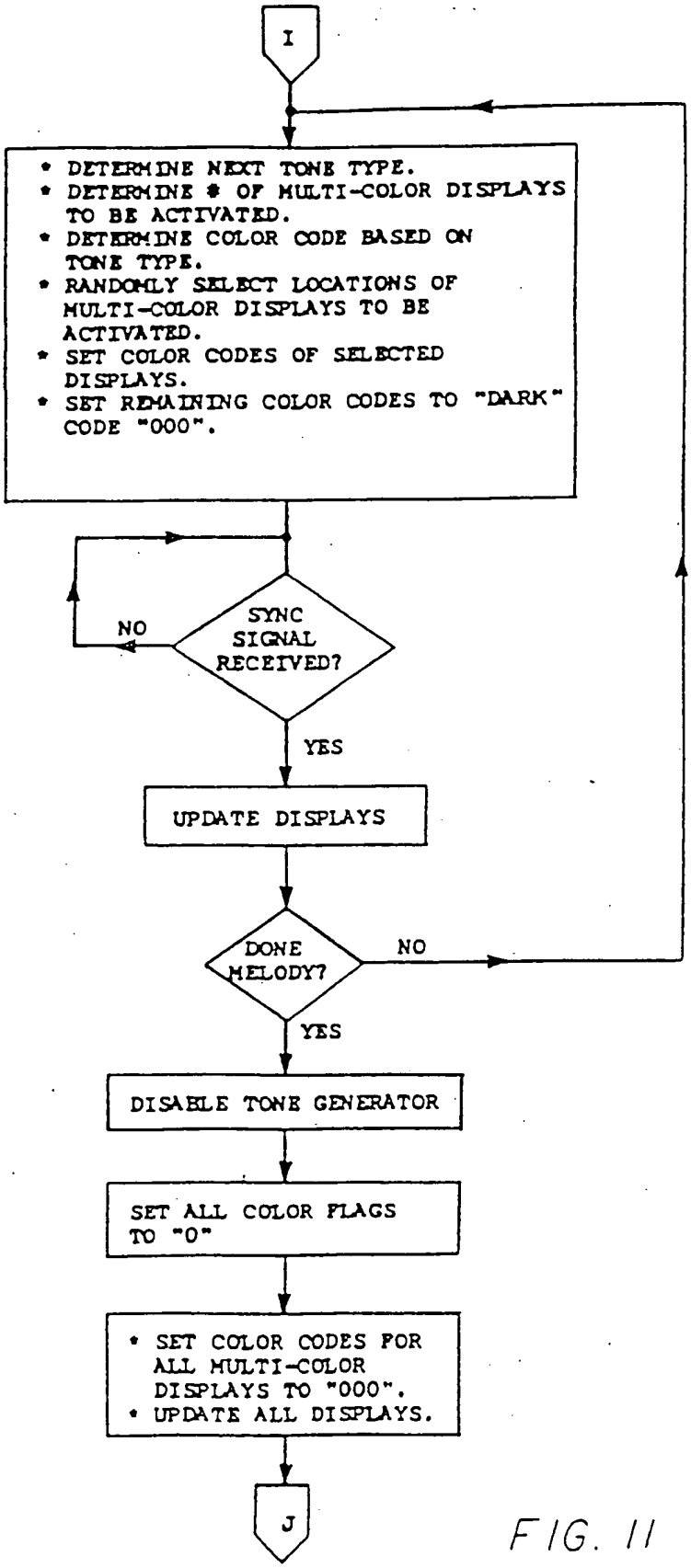

I
• DETERMINE NEXT TONE TYPE.
• DETERMINE # OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
• DETERMINE COLOR CODE BASED ON TONE TYPE.
• RANDOMLY SELECT LOCATIONS OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
• SET COLOR CODES OF SELECTED DISPLAYS.
• SET REMAINING COLOR CODES TO "DARK" CODE "000".
SYNC SIGNAL RECEIVED?
NO
YES
UPDATE DISPLAYS
DONE MELODY?
NO
YES
DISABLE TONE GENERATOR
SET ALL COLOR FLAGS TO "0"
• SET COLOR CODES FOR ALL MULTI-COLOR DISPLAYS TO "000".
• UPDATE ALL DISPLAYS.
J

FIG. 11

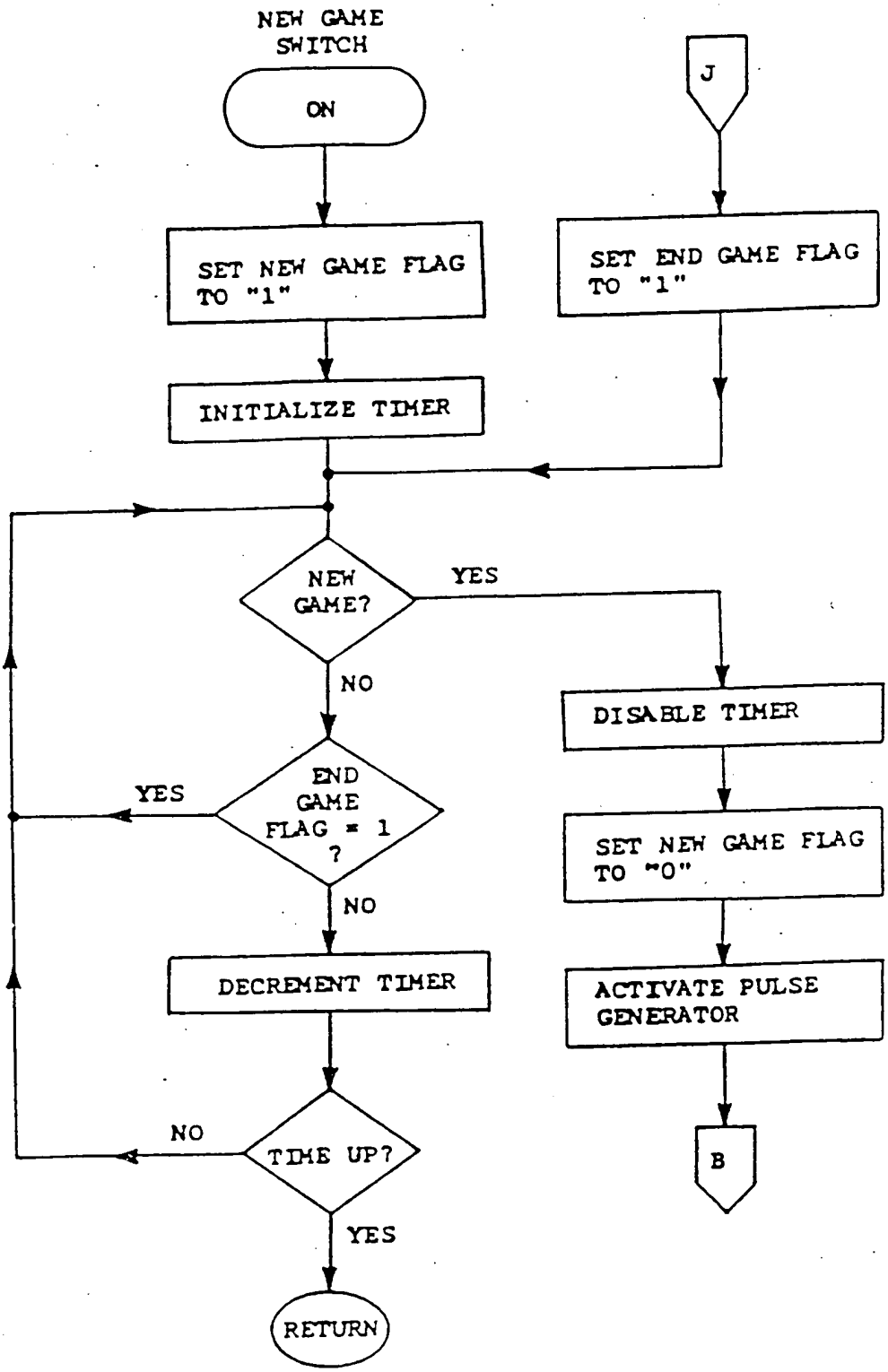

NEW GAME SWITCH
ON
SET NEW GAME FLAG TO "1"
INITIALIZE TIMER
J
SET END GAME FLAG TO "1"
NEW GAME?
YES
NO
DISABLE TIMER
SET NEW GAME FLAG TO "0"
ACTIVATE PULSE GENERATOR
B
END GAME FLAG = 1 ?
YES
NO
DECREMENT TIMER
TIME UP?
NO
YES
RETURN

FIG. 12

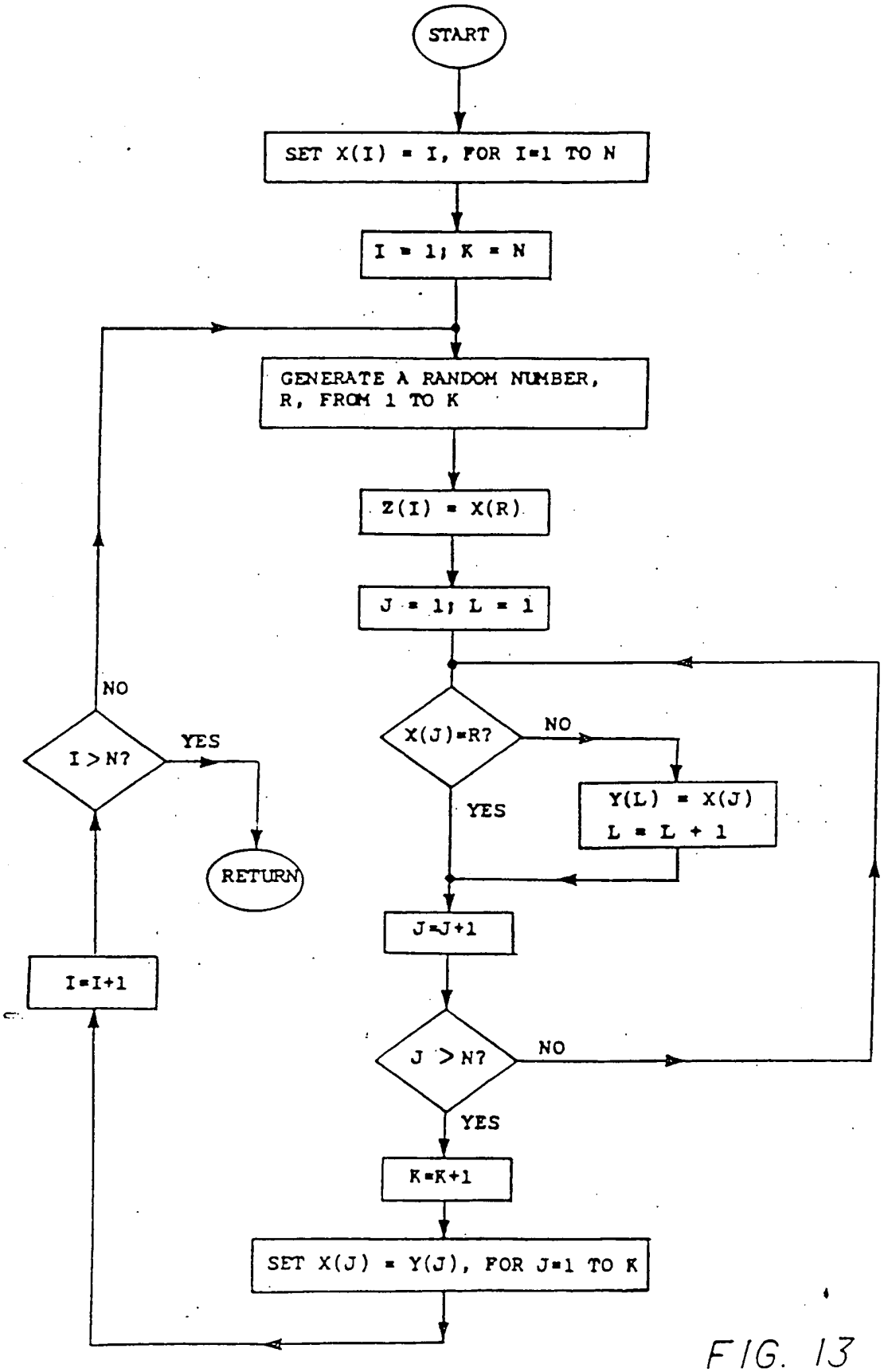

START
SET X(I) = I, FOR I=1 TO N
I = 1; K = N
GENERATE A RANDOM NUMBER, R, FROM 1 TO K
Z(I) = X(R)
J = 1; L = 1
X(J)=R?
NO
YES
Y(L) = X(J)
L = L + 1
J=J+1
J > N?
NO
YES
K=K+1
SET X(J) = Y(J), FOR J=1 TO K
I > N?
NO
YES
RETURN
I=I+1

FIG. 13

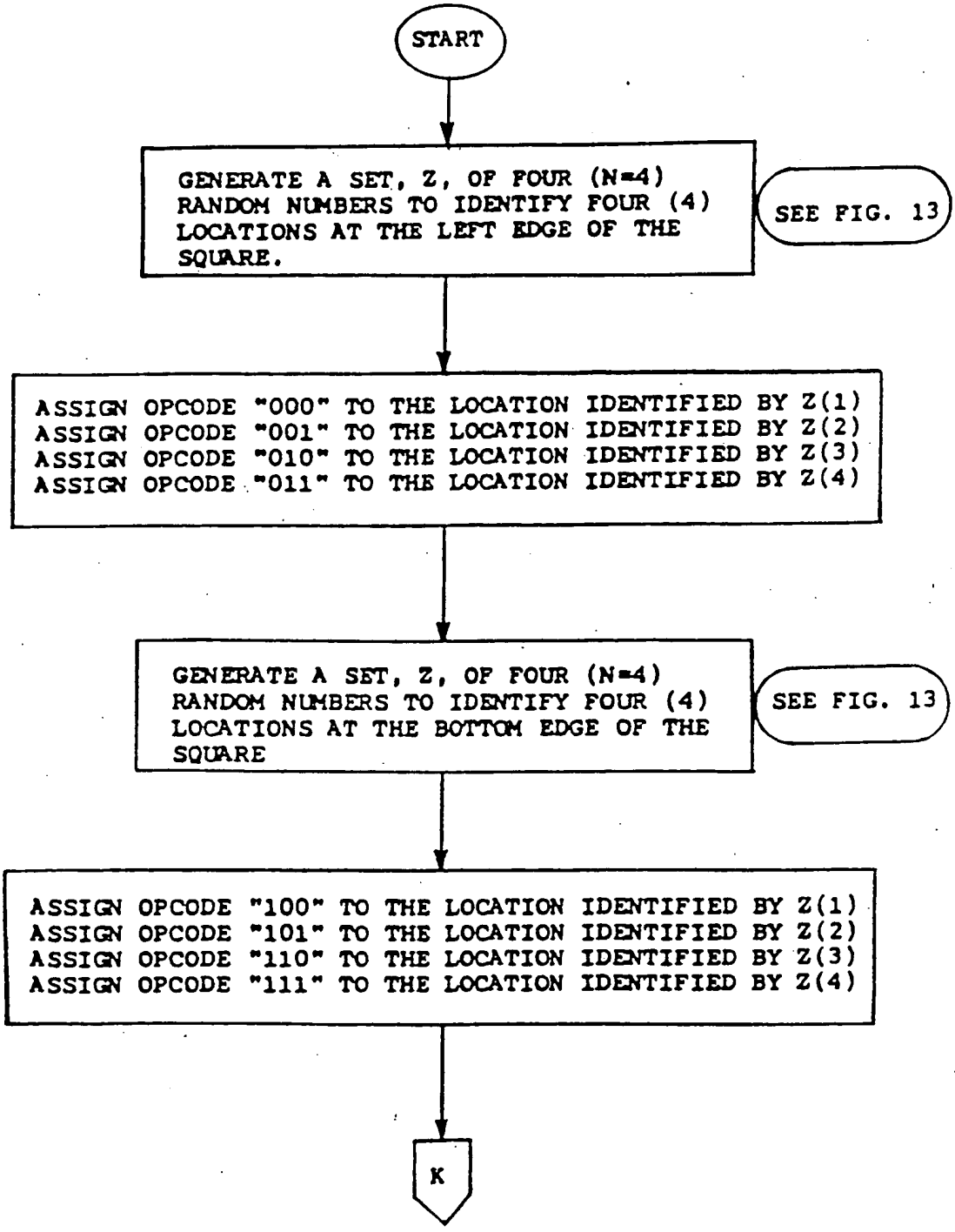

START
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE LEFT EDGE OF THE SQUARE.
SEE FIG. 13
ASSIGN OPCODE "000" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "001" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "010" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "011" TO THE LOCATION IDENTIFIED BY Z(4)
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE BOTTOM EDGE OF THE SQUARE
SEE FIG. 13
ASSIGN OPCODE "100" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "101" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "110" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "111" TO THE LOCATION IDENTIFIED BY Z(4)
K

FIG. 14

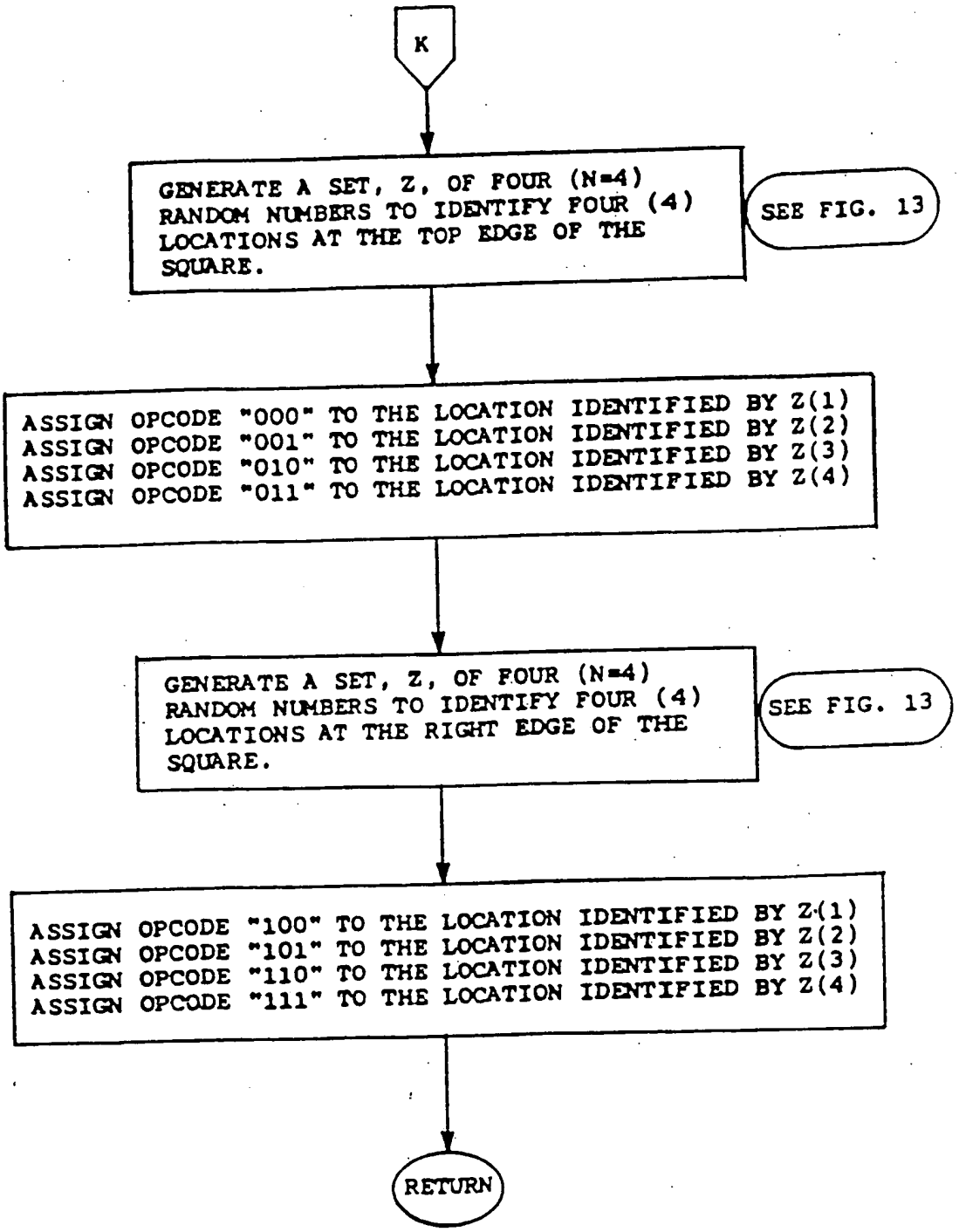

K
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE TOP EDGE OF THE SQUARE.
SEE FIG. 13
ASSIGN OPCODE "000" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "001" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "010" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "011" TO THE LOCATION IDENTIFIED BY Z(4)
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE RIGHT EDGE OF THE SQUARE.
SEE FIG. 13
ASSIGN OPCODE "100" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "101" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "110" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "111" TO THE LOCATION IDENTIFIED BY Z(4)
RETURN

FIG. 15

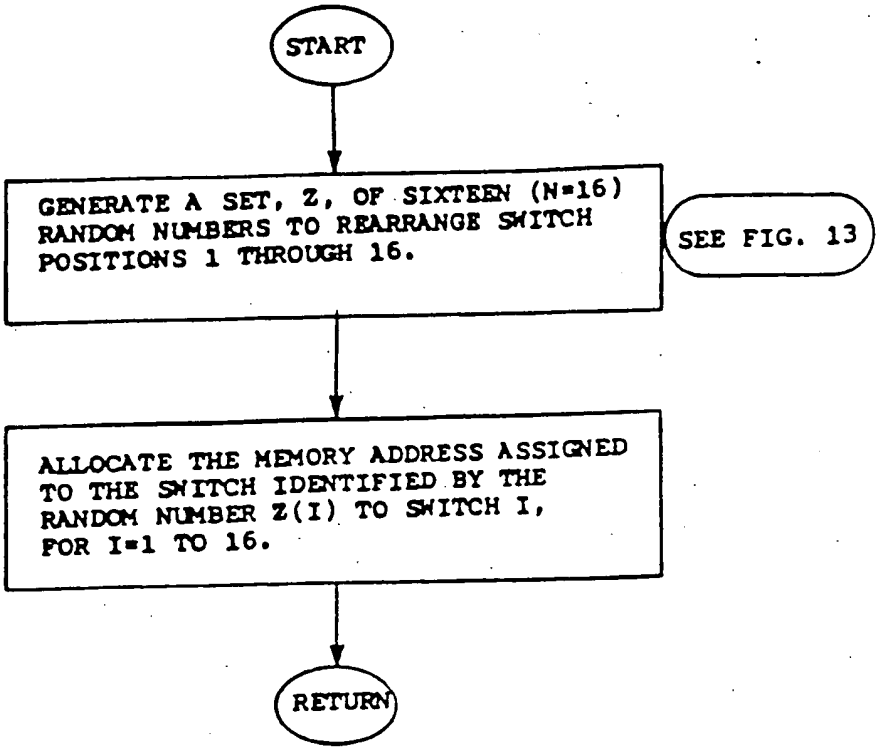

START
GENERATE A SET, Z, OF SIXTEEN (N=16) RANDOM NUMBERS TO REARRANGE SWITCH POSITIONS 1 THROUGH 16.
SEE FIG. 13
ALLOCATE THE MEMORY ADDRESS ASSIGNED TO THE SWITCH IDENTIFIED BY THE RANDOM NUMBER Z(I) TO SWITCH I, FOR I=1 TO 16.
RETURN

FIG. 16

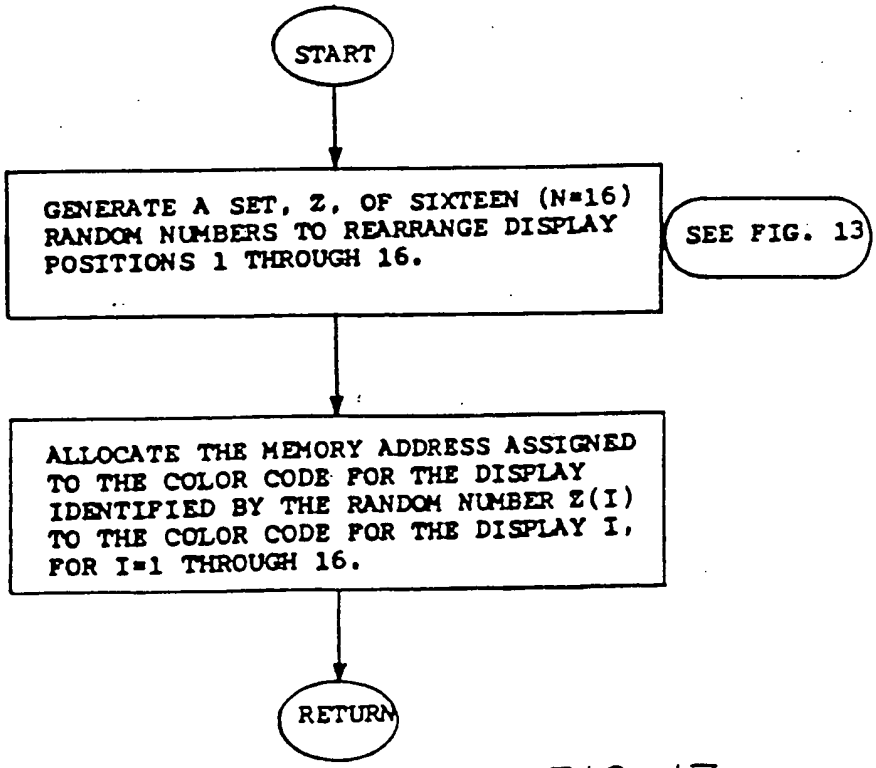

START
GENERATE A SET, Z, OF SIXTEEN (N=16) RANDOM NUMBERS TO REARRANGE DISPLAY POSITIONS 1 THROUGH 16.
SEE FIG. 13
ALLOCATE THE MEMORY ADDRESS ASSIGNED TO THE COLOR CODE FOR THE DISPLAY IDENTIFIED BY THE RANDOM NUMBER Z(I) TO THE COLOR CODE FOR THE DISPLAY I, FOR I=1 THROUGH 16.
RETURN

FIG. 17

LEGEND

N : DIMENSION OF LOGIC GAME = NUMBER OF PREDETERMINED COLORS WHICH MAY BE DISPLAYED, (EXCLUDED REFLECTED COLOR WHEN DISPLAY IS DARK)
= 4 (FOR THE PREFERRED EMBODIMENT)

n : NUMBER OF BINARY BITS IN OPCODE AND COLOR CODE
= ln N + 1 = 3 (FOR THE PREFERRED EMBODIMENT)

I : ROW NUMBER I, I = 1, ..., N

J : COLUMN NUMBER J, J = 1, ..., N

DIR : ROUTE DIRECTION BETWEEN TWO ADJACENT ROUTING SQUARES;
"R" DENOTES RIGHT
"U" DENOTES UP
"L" DENOTES LEFT
"D" DENOTES DOWN

T : OPCODE TRANSMITTER; T = 1, ..., 2N

R : OPCODE RECEIVER; R = 1, ..., 2N

RC(T) : RECEIVER CONNECTED TO TRANSMITTER "T"

TC(R) : TRANSMITTER CONNECTED TO RECEIVER "R"

W(I,J) : STATUS OF SWITCH LOCATED AT ROW "I" AND COLUMN "J," OR STATUS OF ROUTING SQUARE AT ROW "I" AND COLUMN "J"

TCODE(T) : OPCODE AT TRANSMITTER "T"

RCODE(R) : OPCODE AT RECEIVER "R"

C(R) : COLOR CODE AT RECEIVER "R"

x(i) : THE ith BIT OF OPCODE "X"

y(i) : THE ith BIT OF OPCODE "Y"

cb(i) : THE ith BIT OF COLOR CODE "C"

C1(I,J) : COLOR CODE AT THE RIGHT EDGE OF THE ROUTING SQUARE LOCATED AT ROW "I" AND COLUMN "J"

C2(I,J) : COLOR CODE AT THE TOP EDGE OF THE ROUTING SQUARE LOCATED AT ROW "I" AND COLUMN "J"

C(I,J) : COLOR CODE SELECTED FOR DISPLAY AT THE ROUTING SQUARE LOCATED AT ROW "I" AND COLUMN "J"

$\oplus$: EXCLUSIVE OR BOOLEAN FUNCTION

$\odot$: EXCLUSIVE NOR BOOLEAN FUNCTION

EXPLANATION OF PROGRAM VARIABLES OF FIGS. 19 – 22

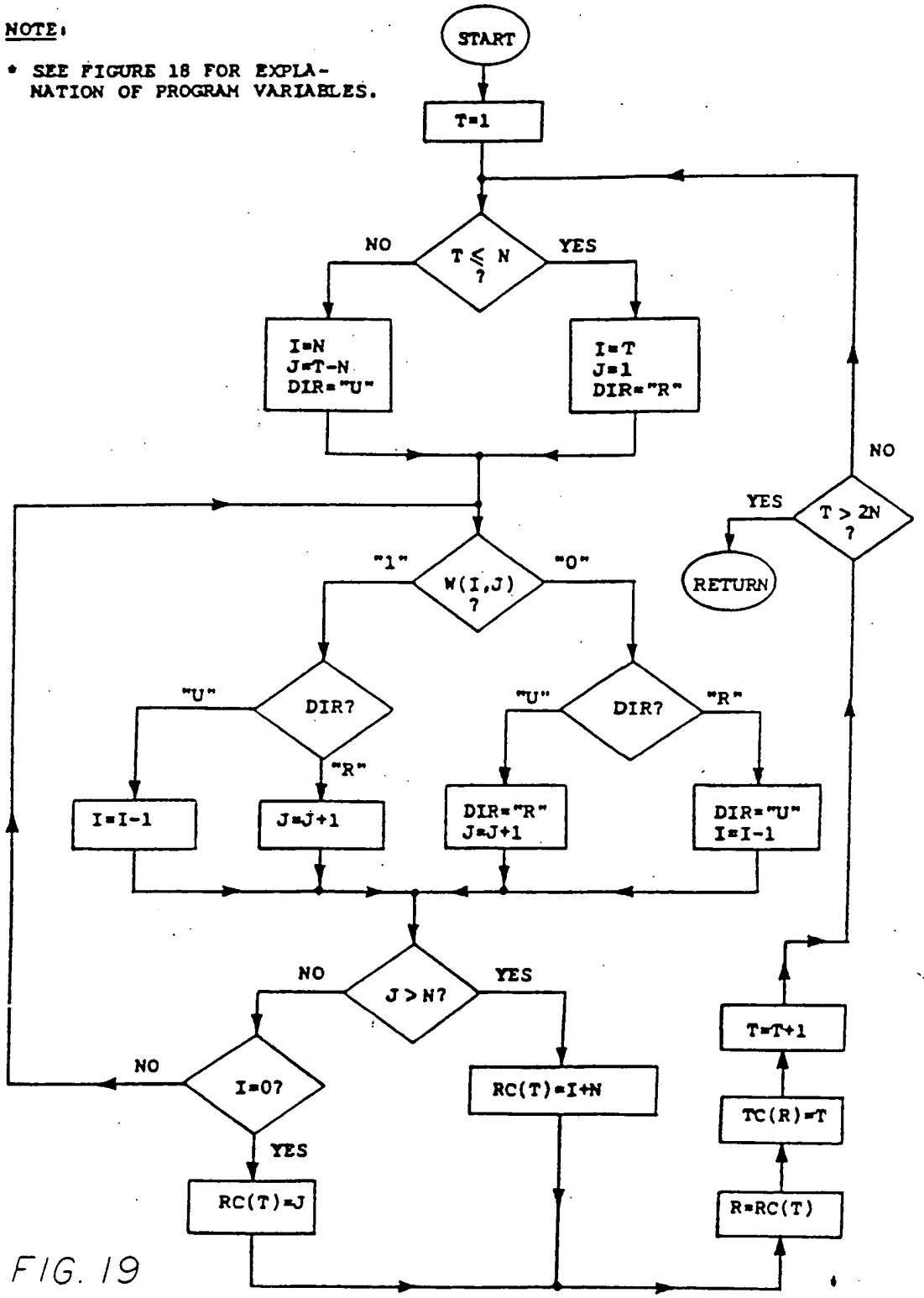
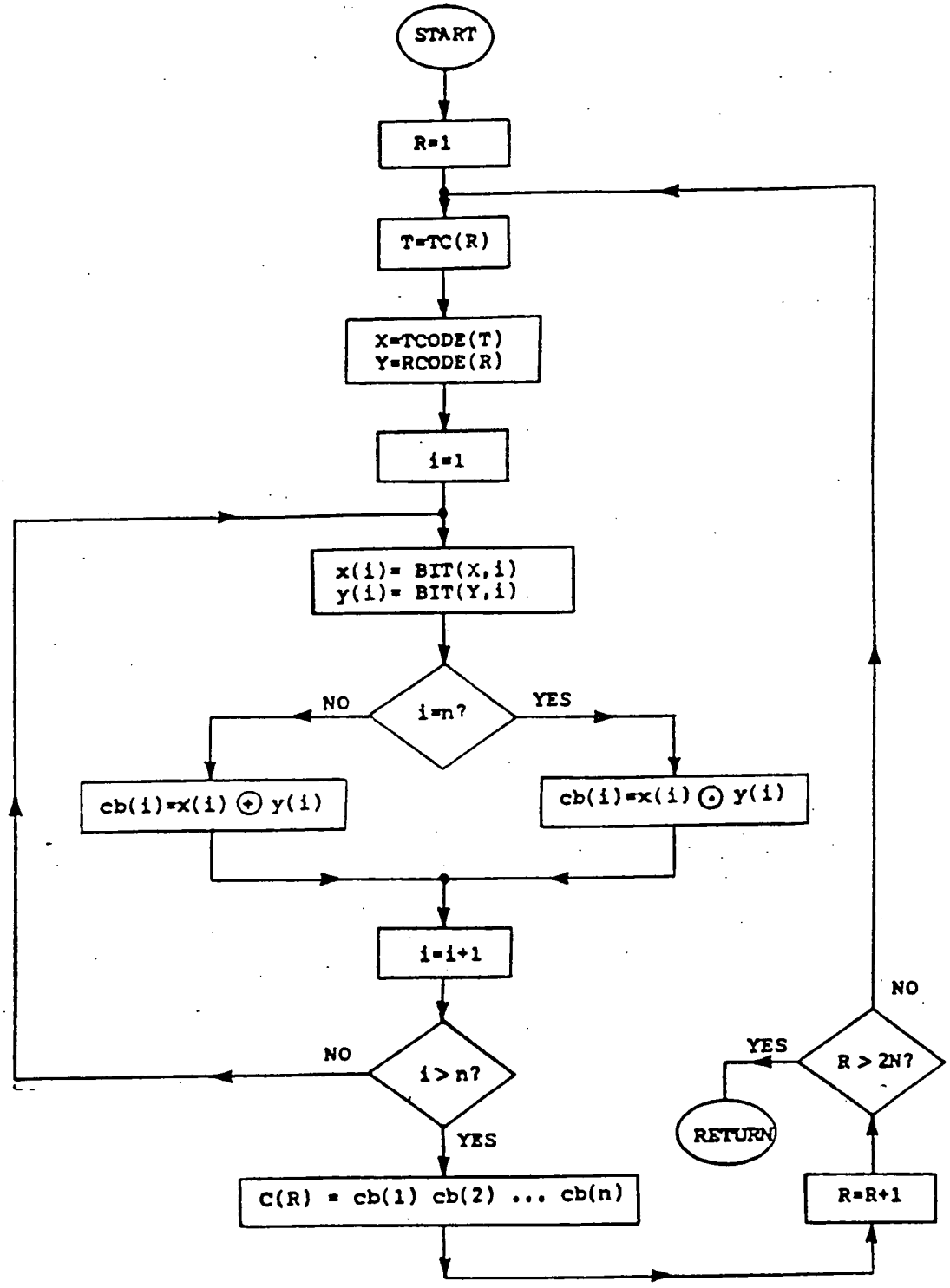

NOTE:
* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.
START
T=1
T ≤ N ?
NO
YES
I=N
J=T-N
DIR="U"
I=T
J=1
DIR="R"
W(I,J) ?
"1"
"0"
DIR?
"U"
"R"
I=I-1
J=J+1
DIR="R"
J=J+1
DIR="U"
I=I-1
J > N?
NO
YES
I=0?
NO
YES
RC(T)=J
RC(T)=I+N
T > 2N ?
YES
NO
RETURN
T=T+1
TC(R)=T
R=RC(T)

FIG. 19



NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

FIG. 20

NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

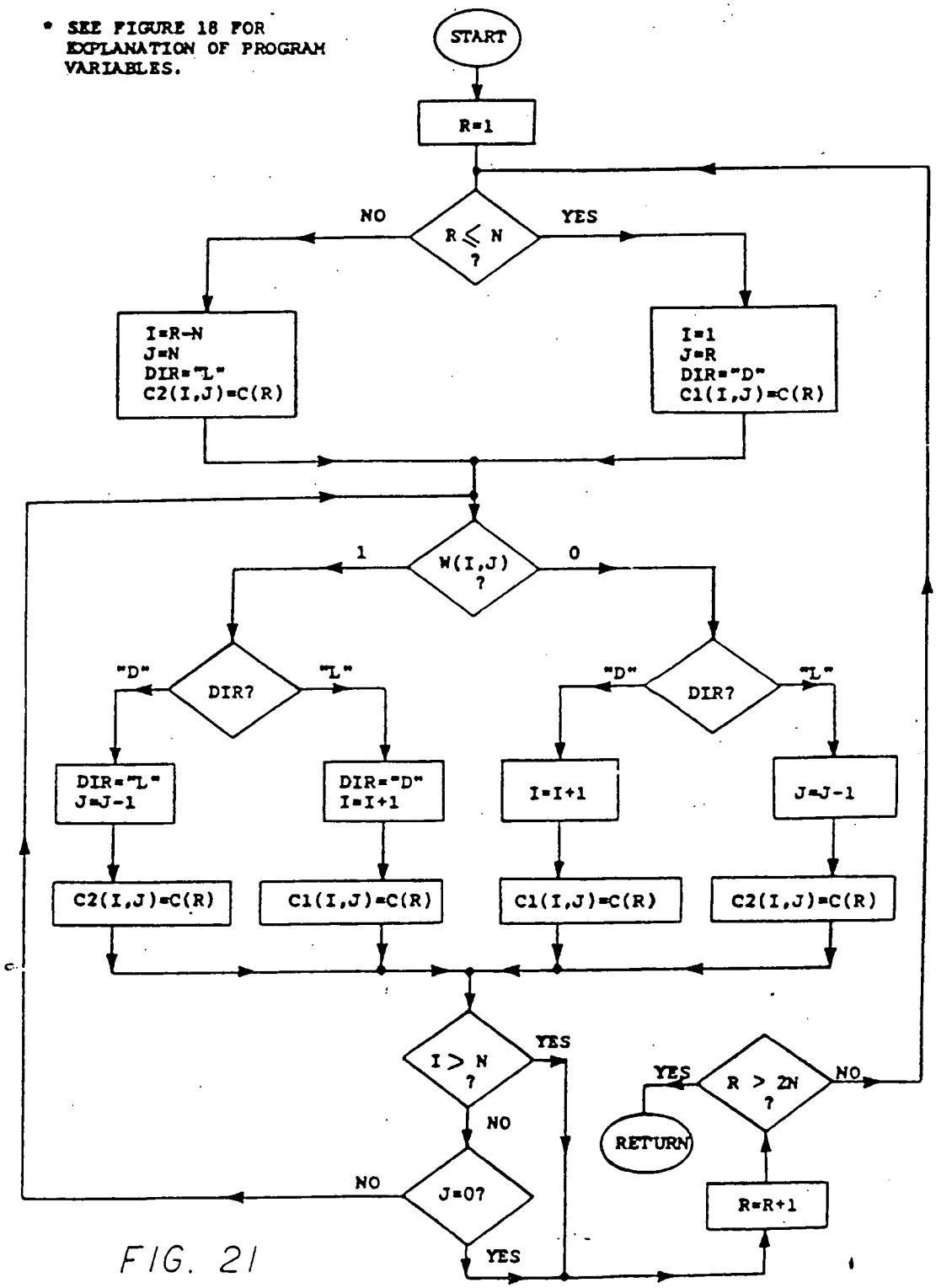
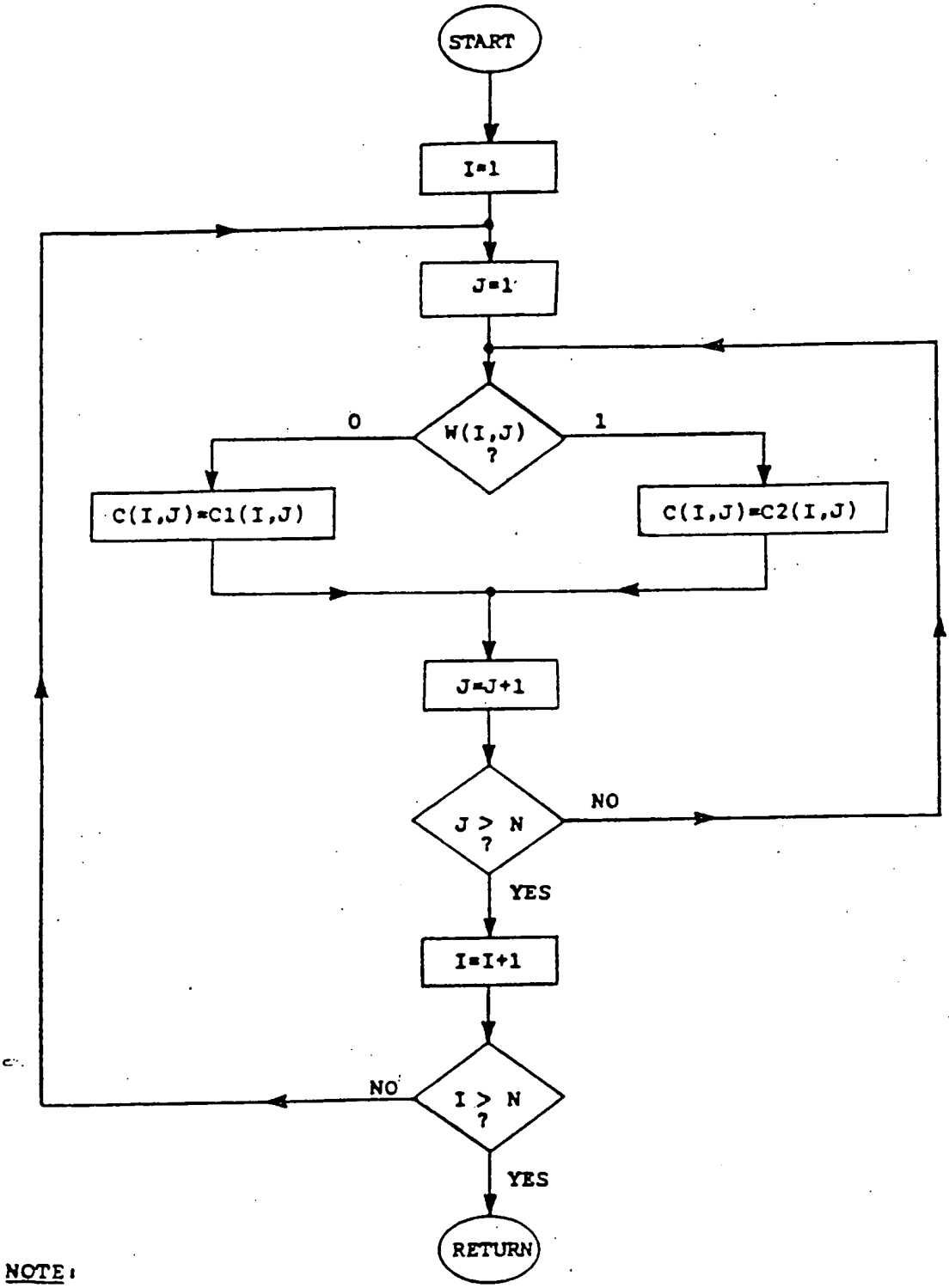


FIG. 21



NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

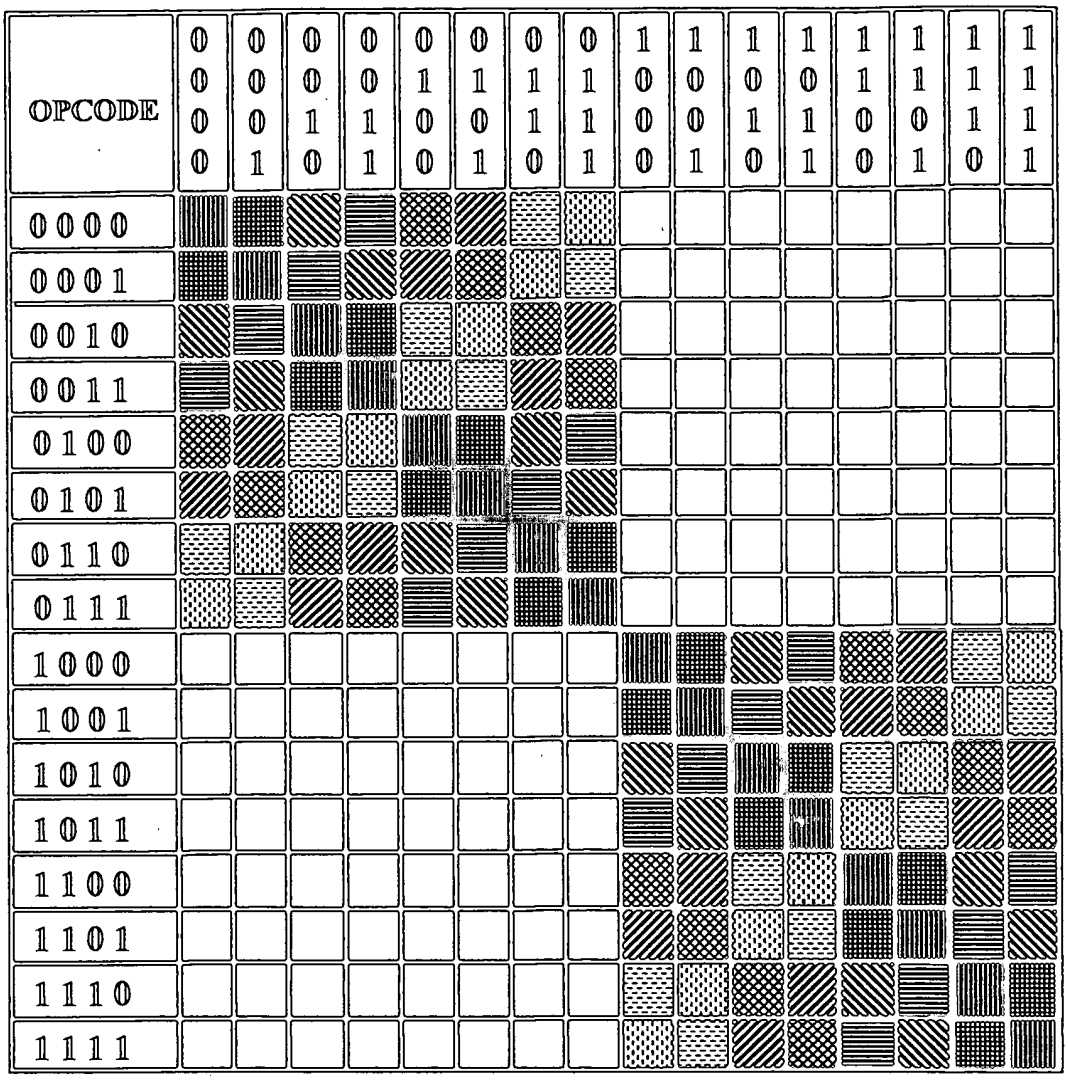
FIG. 22

OPCODE	0 0 0 0	0 0 0 1	0 1 0 0	0 1 1 1	1 0 0 0	1 0 0 1	1 1 1 0	1 1 1 1
0 0 0								
0 0 1								
0 1 0								
0 1 1								
1 0 0								
1 0 1								
1 1 0								
1 1 1								

COLOR CODE	1 0 0	1 0 1	1 1 0	1 1 1	0 - -
COLOR					

COLOR ASSIGNMENT FOR N = 4

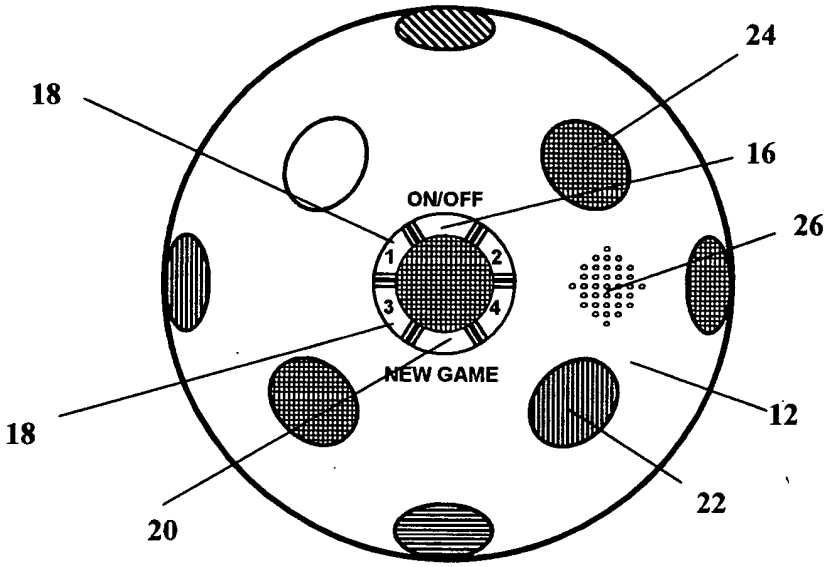
FIG. - 23 -

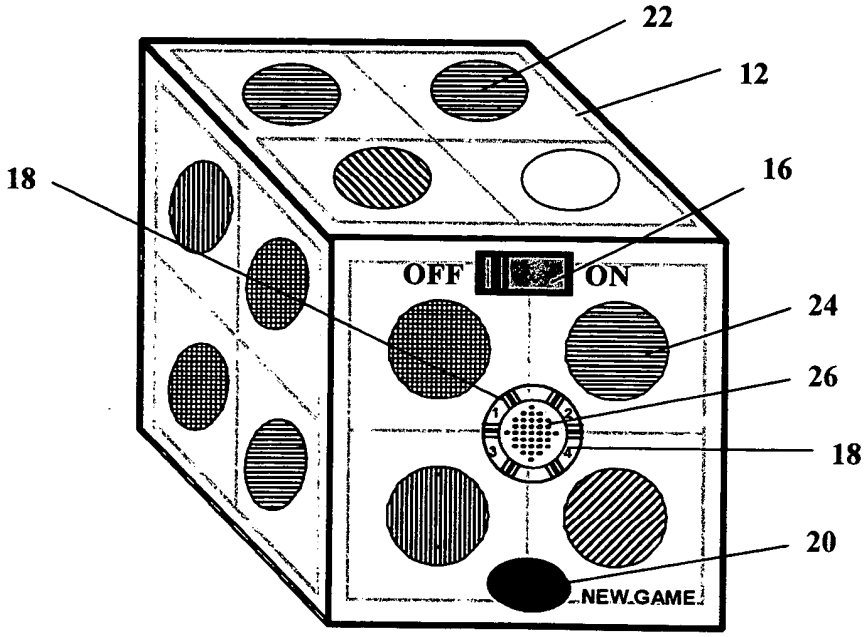


COLOR CODE	1000	1001	1010	1011	1100	1101	1110	1111	0—
COLOR									

COLOR ASSIGNMENT FOR N = 8

FIG. - 24 -





MAPPING OF INDICATORS ON 3 DIMENSIONAL CONFIGURATION

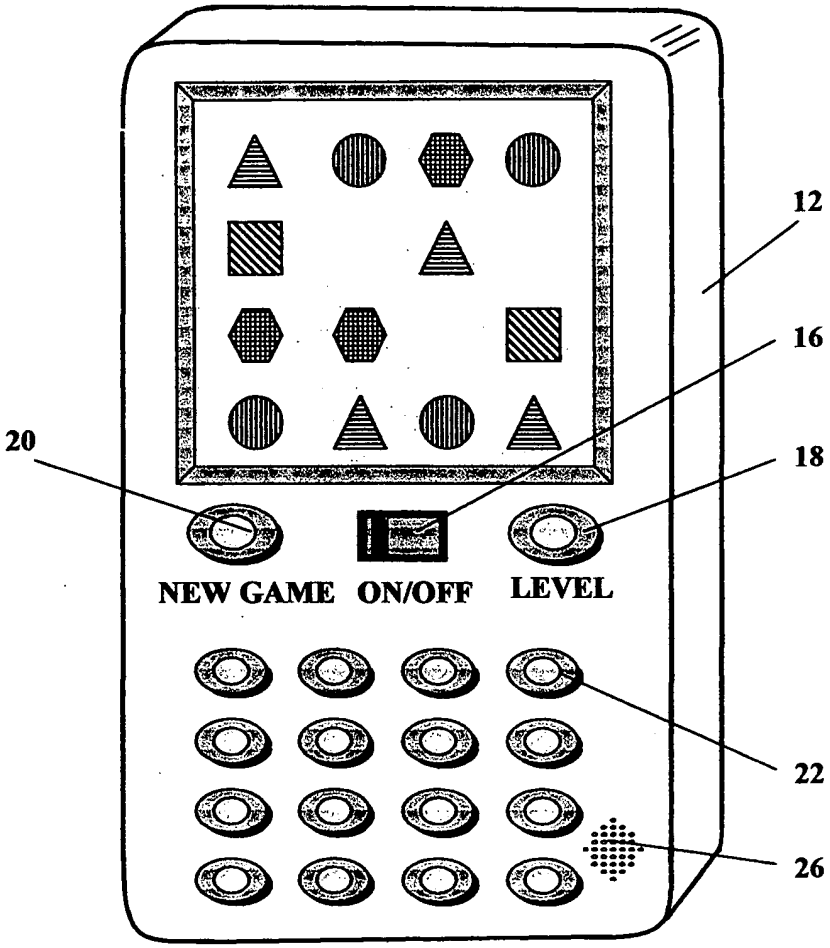
FIG. - 25 -

OPCODE	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0 0 0								
0 0 1								
0 1 0								
0 1 1								
1 0 0								
1 0 1								
1 1 0								
1 1 1								

COLOR CODE	1 0 0	1 0 1	1 1 0	1 1 1	0 - -
COLOR					

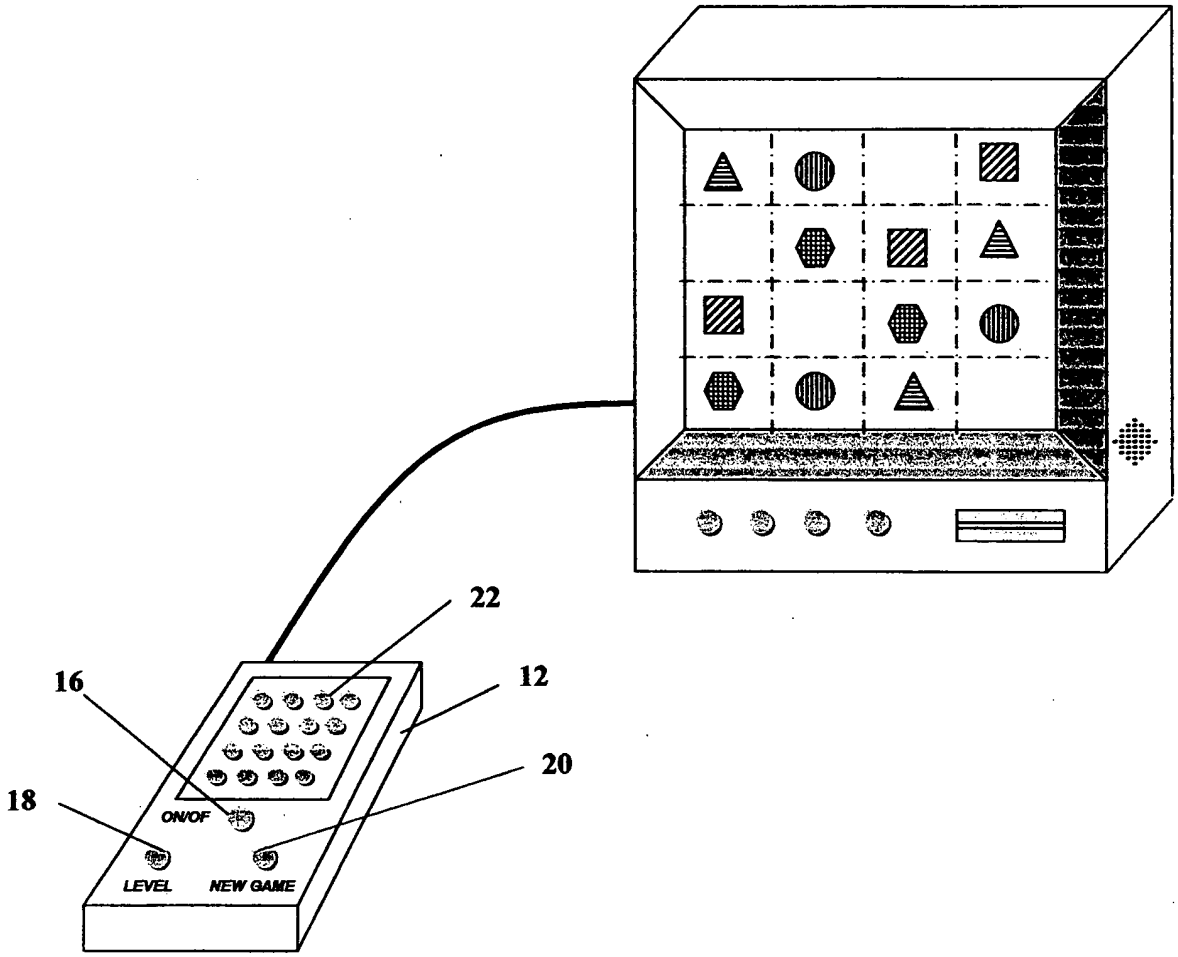
COLOR ASSIGNMENT FOR N = 4
(Color codes assigned to 2 colors)

FIG. - 26 -



ALTERNATE EMBODIMENT USING LCD SCREEN

FIG. - 27 -



CONNECTION TO VIDEO MONITOR

FIG. - 28 -

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